**Supplemental Data**
**Neuron, volume 55**

# Contributions of the Amygdala to Reward Expectancy and Choice Signals in Human Prefrontal Cortex

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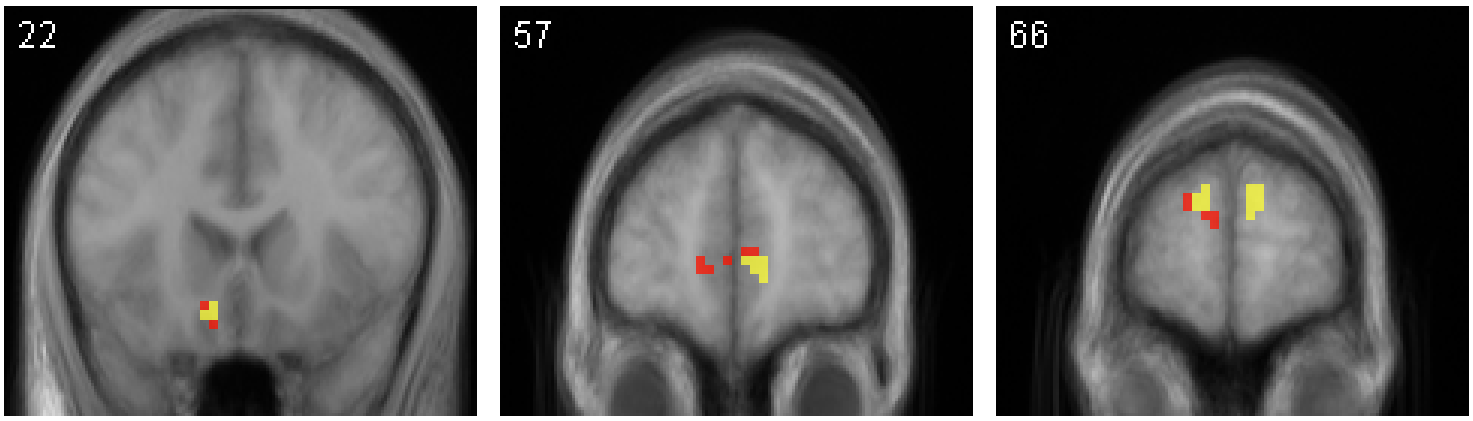
# Figure S1

Controls > amygdala (expected reward)

**A** Individual model parameters




**B** Excluding all error trials

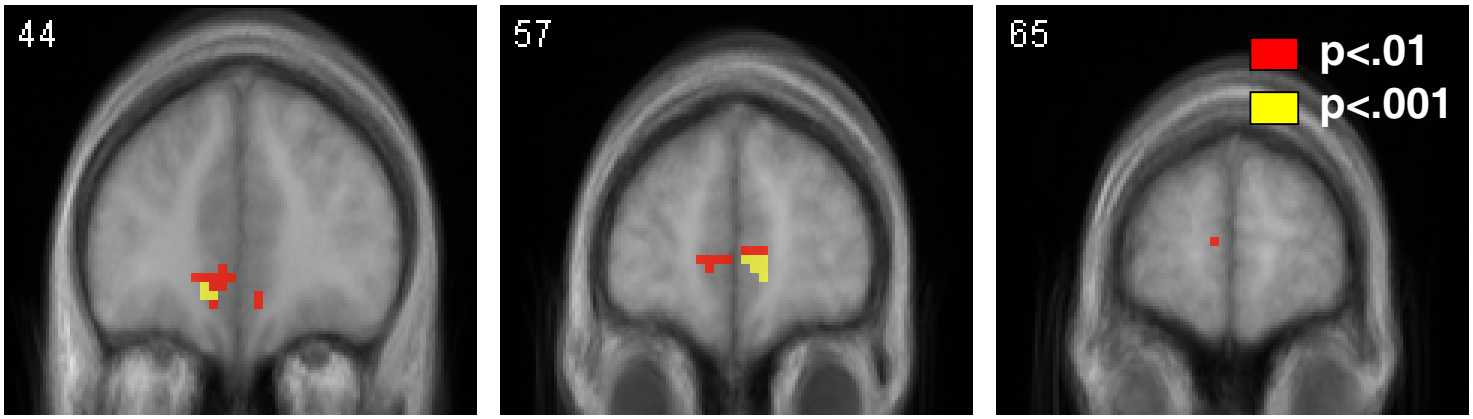


**Figure S1. Controlling for the effects of behavioral differences between amygdala subjects and controls on signals pertaining to expected reward value.** To control for the effects of differences in behavioral performance between the amygdala subjects and control subjects on the fMRI results for the comparison of expected reward signals (Figure 5B), we performed two additional tests: **(A)** We first compared expected reward signals between the amygdala subjects and controls, but this time with model parameters derived from the best log likelihood fits of the computational model to the behavioral data for each amygdala subject individually. This controls for the possibility that the model accounts equally well for the behavioral data in the amydala lesion subjects as the controls, but that the amygdala subjects and controls only differ in the model-parameters. Contrary to this possibility, this analysis still revealed significant differences between amygdala subjects and controls in expected reward signals (again at $p<0.001$), again consistent with the results reported in the main paper. **(B)** We then compared expected reward signals between the two amygdala subjects and controls using only those trials for which subjects made correct choices given the underlying contingencies. Here, as in the results reported in the main paper, we used the model-parameters derived from the control subjects. Consistent with the results reported in the main paper (Fig. 5B) this analysis still showed significant differences between amygdala subjects and controls in encoding of expected rewards in medial PFC at $p<0.001$.

# Figure S2

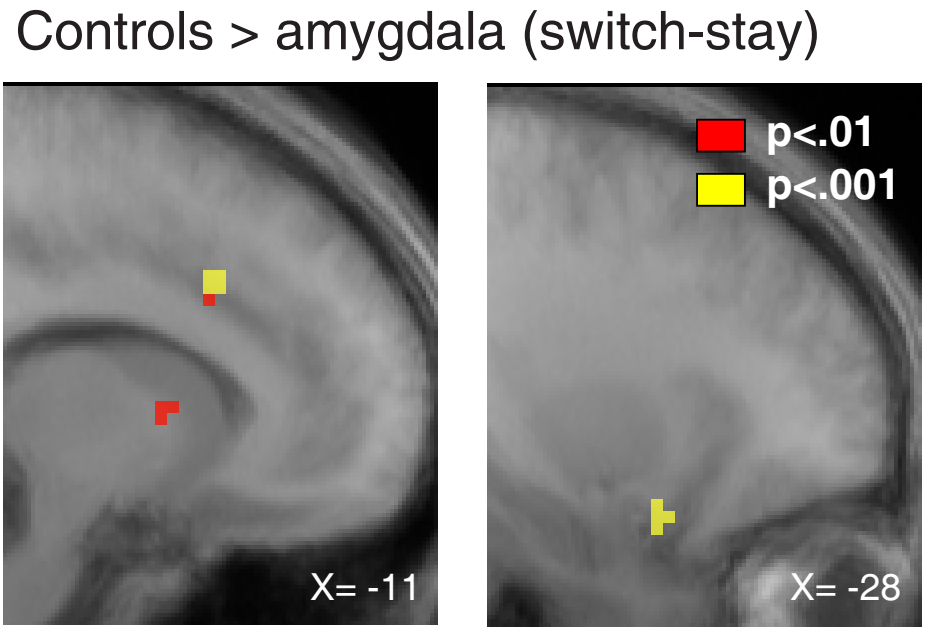
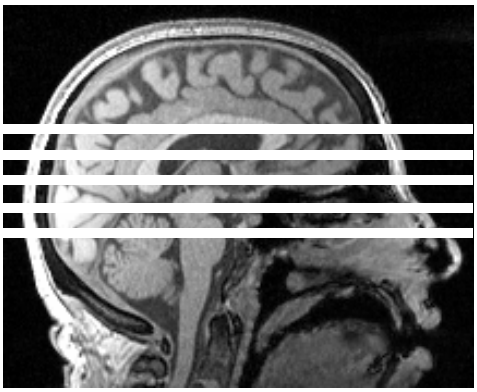
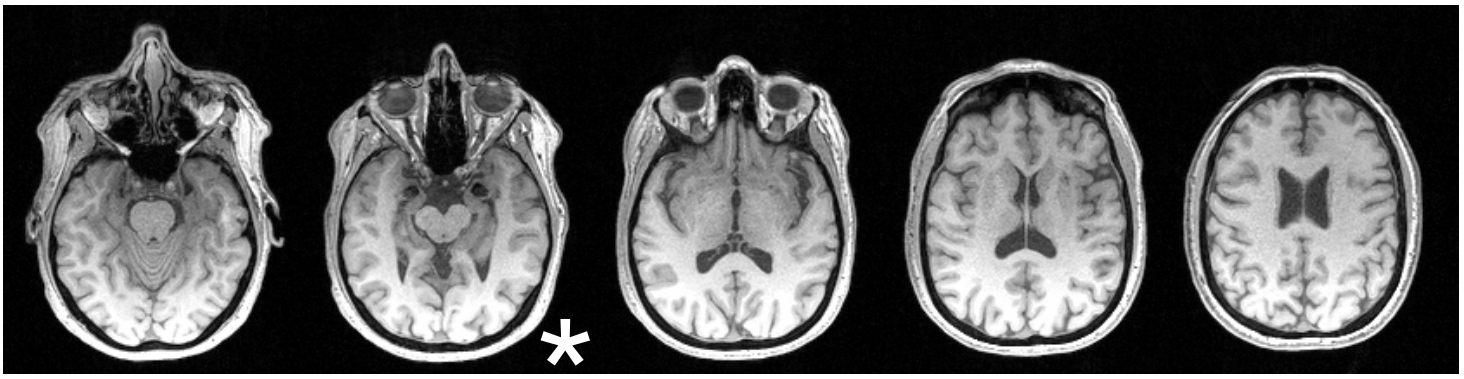


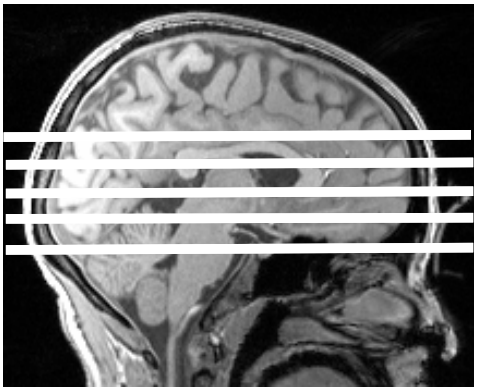
**Figure S2. Controlling for behavioral differences between amygdala lesion subjects and controls in signals pertaining to behavioral choice.** To further control for the effects of differences in behavioral performance between the amygdala subjects and control subjects on the fMRI data, we restricted our analysis to only those trials in which both amygdala subjects and controls made correct choices (given the underlying contingencies). For this, we modeled separately trials in which subjects' action of staying with the same choice, or switching choice was correct given the underlying task contingency, from trials in which subjects' actions were incorrect given the underlying task contingency. In this figure we show the results of a comparison between switch-stay trials in amygdala subjects and controls, similar to that shown in Fig. 4C in the main paper. Even after controlling for behavioral differences, this analysis revealed a similar result to that reported in Fig. 4C. That is, amygdala subjects showed significantly reduced activity in posterior lateral orbitofrontal cortex/anterior insula and anterior cingulate cortex on switch-stay trials compared to controls (an effect which was still significant at $p<0.001$).

# Figure S3



SM





AP

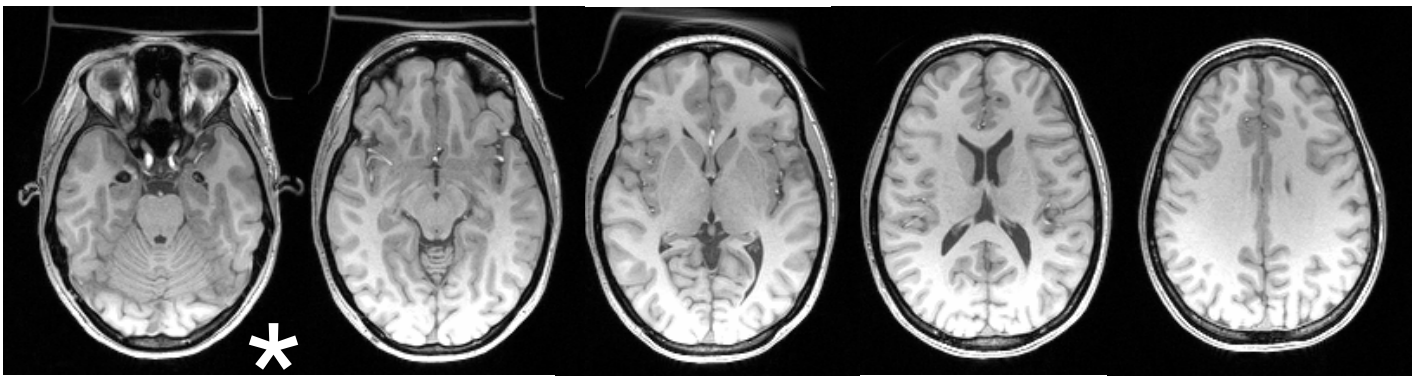


**Figure S3. Multiple axial slices for both amygdala lesion subjects.** Multiple axial slices of T1-weighted structural images are shown from both amygdala subjects. Axial slices marked with an asterisk are shown in Figure 1, in which the amygdala lesions for both subjects are compared to the intact amygdala of a typical control subject. In the asterisk marked slices, the bilateral calcification of the amygdala due to Urbach-Wiethe disease can be seen as a loss of signal.

# Figure S4

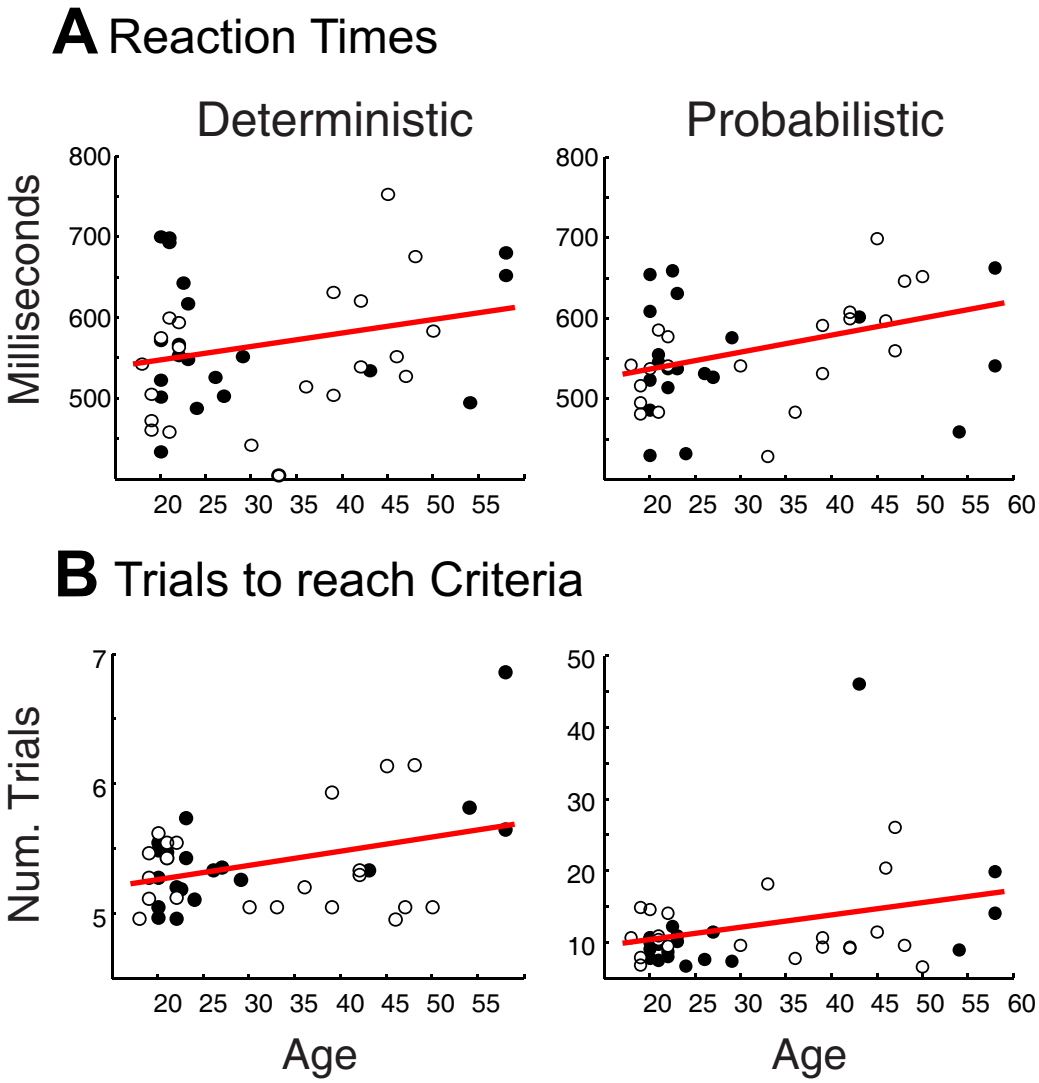

A Reaction Times
Deterministic
Probabilistic
Milliseconds
800
700
600
500
20 25 30 35 40 45 50 55
20 25 30 35 40 45 50 55 60
B Trials to reach Criteria
Num. Trials
7
6
5
50
40
30
20
10
Age
Age

**Figure S4. Age effects on task performance.** Plots of correlations between behavioral measures of subject performance on the task and age. Out of the range of behavioral measures tested, two measures showed significant effects of age: reaction time in selecting a choice (from stimulus onset to choice selection) was significant in the probabilistic ($R^2$=0.2; p<0.005) but not deterministic task ($R^2$=0.064; p=0.10), and the total number of trials to reach criteria (probabilistic: $R^2$=0.12; p<0.05; deterministic $R^2$=0.09; p<0.05). Control subjects are shown as black and white colored circles (black denotes the subset of control subjects also included in the fMRI analysis).

# Figure S5

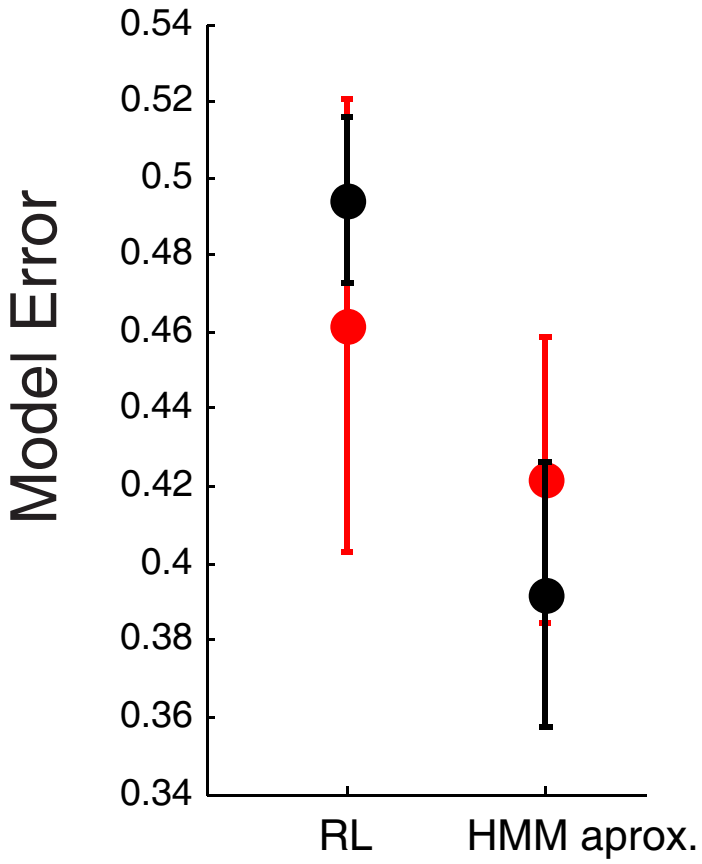

Model Error
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
RL
HMM aprox.

**Figure S5. Out-of-sample model errors.** The HMM approximation used in this paper, and a simpler RL model (Rescorla-Wagner) were fitted to subjects' behavior. To test for model overfitting, model errors (negative log llikelihoods) obtained from training both models on all 16 control subjects used as fMRI controls (in black) were compared to out-of-sample model errors obtained from training both models on 15 subjects, and testing them on the subject that was left out (in red). This was repeated 16 times. The difference between the training and out-of-sample errors were not significantly different, indicating that the models are not over-fitted with this training procedure. Furthermore, although the simple RL model, and HMM approximation model have the same number of parameters; the latter provides a better fit to subjects behavior.